What is claimed is:

1. A direct-electrochemical-oxidation fuel cell for generating electrical energy from a solid-state organic fuel comprising:

a cathode provided with an electrochemical-reduction catalyst that promotes formation of oxygen ions from an oxygen-containing source at the cathode;

an anode provided with an electrochemical-oxidation catalyst that promotes direct electrochemical oxidation of the solid-state organic fuel in the presence of the oxygen ions to produce electrical energy; and

a solid-oxide electrolyte disposed to transmit the oxygen ions from the cathode to the anode, wherein

direct electrochemical oxidation at the anode occurs according to the reaction:

$$C+2O^{2-} \rightarrow CO_2 + 4e^-$$

2. The fuel cell according to claim 1, wherein formation of the oxygen ions at the cathode proceeds according to the reaction:

$$O_2 + 4e^- \rightarrow 2O^{2-}$$

3. The fuel cell according to claim 1, wherein the solid-state organic fuel is coal, graphite, biomass or a combination thereof.

4. The fuel cell according to claim 3, wherein the biomass is selected from a group consisting of peat, rice hulls, and corn husks.

5. The fuel cell according to claim 1, wherein the direct electrochemical oxidation at said anode produces a product comprising a CO_2 concentration of at least 50 mol %.

6. The fuel cell according to claim 1, wherein the electrochemical-reduction catalyst is lanthanum strontium manganese oxide.

7. The fuel cell according to claim 1, wherein the electrochemical-reduction catalyst is selected from the group consisting of LSF; LSCF; SSC; $YBa_2Cu_3O_y$, wherein y is an integer having values within a range of 7-9; $La_{0.99}MnO_3$; $LaMnO_3$; $La_xSr_yMn_3$ and $La_xCa_yMn\theta_3$, wherein x is a number having values within a range of 0.6-0.95, and y is a number having values within arange of 0.1-0.4.

8. The fuel cell according to claim 1, wherein the electrochemical-reduction catalyst is selected from the group consisting of material having a general formula of A_xByCO_3, wherein A is selected from the group consisting of La, Gd, Sm, Nd, Pr, Tb and Sr, B is selected from the group consisting of Sr, Ce, and Co, x is a number having values within arange of 0.6-0.94, and y is a number having values within a range of 0.1-0.4.

9. . The fuel cell according to claim 1, wherein the electrochemical-oxidation catalyst provided to the anode includes platinum.

10. The fuel cell according to claim 1, wherein the electrochemical-oxidation catalyst includes Rhenium.

11. The fuel cell according to claim 10, wherein the electrochemical-electrochemical oxidation catalyst is Re-NiO/YSZ.

12. The fuel cell according to claim 10, wherein the electrochemical-oxidation catalyst is Cu oxide-Pt.

13. The fuel cell according to claim 1, wherein the solid-oxide electrolyte is selected from the group consisting of doped oxides of Bi, Zr, Hf, Th, and Ce with either alkaline earth oxides such as CaO or MgO, or rare-earth oxides such as Sc_2O_3, Y_2O_3, Yb_2O_3, and the like. For example, embodiments of the present invention include a solid-oxide electrolyte 18 comprising at least one of Bi_2O_2, $(Bi_20_7)o._{75}(Y2\theta_3)_{0{\cdot}25}$, BaTho.$_9Gd_0$.i0$_3$, Lao.gSro.2Gao.8Mgo.2O$_3$, $(Ce_2)o._8(GdOo._5)o.2$, $(Zr0_2)o.9(Sc_20_3)_0.i$, $(ZrO_2)o.9(Y_2O_3)o.!$, $(ZrO_2)_0.87(CaO)_{0{\cdot}13}$, $(La_20_3)o.95(SrO)_{0{\cdot}05}$.

14. The fuel cell according to claim 1, wherein the solid-oxide electrolyte is selected from the group consisting of yttrium-stabilized zirconium and bismuth oxide.

15. The fuel cell according to claim 1 further comprising a housing that encloses the anode for receiving the solid-state organic fuel.

16. The fuel cell according to claim 15 further comprising feed passage through which the solid-state organic fuel can be inserted into the housing.

17. The fuel cell according to claim 1, wherein the electrochemical oxidation that occurs at the anode produces a product comprising a NO_x concentration of less than 5 mol %, wherein x is an integer within a range of 1 to 3.

18. The fuel cell according to claim 17, wherein the fuel cell has a maximum operating temperature of about 1200^0C.

19. The fuel cell according to claim 1, wherein the direct electrochemical oxidation that occurs at the cathode results in a product comprising a CO concentration that is less than 10 mol %.

20. The fuel cell according to claim 19, wherein the fuel cell has a maximum operating temperature of about 1200^{0}C.

21. The fuel cell according to claim 1, wherein the fuel cell produces an electrical current of at least 100 mA/cm^2 for a period of time lasting at least 48 hours.

22. The fuel cell according to claim 1, wherein the fuel-conversion efficiency of the fuel cell is at least 30 mol % at 950^{0}C.

23. A direct-electrochemical-electrochemical oxidation fuel cell for generating electrical energy from a solid-state organic fuel comprising:

a cathode provided with an electrochemical-reduction catalyst that promotes the formation of ions from an ion source at the cathode;

a anode provided with an electrochemical-oxidation catalyst that includes a sulfur-resistant material and promotes electrochemical oxidation of the solid-state organic fuel in the presence of the ions formed at the cathode to produce electrical energy; and

a solid-oxide electrolyte disposed to transmit the ions from the cathode to the anode.

24. The fuel cell according to claim 23, wherein the sulfur-resistant material includes at least one of Re, Mn and Mo.

25. The fuel cell according to claim 24, wherein the sulfur-resistant material is selected from the group consisting of Re-NiO/YSZ, Cu oxide-Pt.

26. The fuel cell according to claim 23, wherein the electrochemical-reduction catalyst is lanthanum strontium manganese oxide.

27. The fuel cell according to claim 23, wherein the electrochemical-reduction catalyst *is* selected from the group consisting of LSF; LSCF; SSC; YBa_2Cu_3Oy, wherein y is an integer having values within a range of 7-9; $Lao._{99}Mn0_3$; $LaMnO_3$; $La_xSr_yMn_3$ and $La_xCa_yMn\theta_3$, wherein x is a number having values within a range of 0.6-0.95, and y is a number having values within a range of 0.1-0.4.

28. The fuel cell according to claim 23, wherein the ions formed at the cathode are oxygen ions formed according to the reaction:

$$O_2 + 4e^- \rightarrow 2O^{2-}$$

29. The fuel cell according to claim 23, wherein the solid-state organic fuel is coal, graphite, biomass, polymers or a combination thereof.

30. The fuel cell according to claim 29, wherein the biomass is selected from a group consisting of peat, rice hulls, and corn husks.

31. The fuel cell according to claim 23, wherein the solid-oxide electrolyte is selected from the group consisting of doped oxides of Bi, Zr, Hf, Th, and Ce with either alkaline earth oxides such as CaO or MgO, or rare-earth oxides such as Sc_2O_3, Y_2O_3, Yb_2O_3, and the like. For example,embodiments of the present invention include a solid-oxide electrolyte 18 comprising at least one of Bi_2O_2, $(Bi_2O_7)_{0.75}(Y_2O_3)_{0.25}$, $BaTh_{0.9}Gd_{0.1}O_3$, $Lao._8Sro._2Gao._8Mgo._20_{35}$ $(Ce_2)_{0.8}(GdO_{0.5})_{0.2}$, $(Zr0_2)o.9(Sc_20_3)_{0.1}$, $(ZrO_2)_{0.9}(Y_2O_3)_{0.1}$, $(Zr0_2)_{0.87}(CaO)o.i3$, $(La_20_3)o.95(SrO)o.o5$.

32. The fuel cell according to claim 31, wherein the solid-oxide electrolyte is selected from the group consisting of yttrium-stabilized zirconium and bismuth oxide.

33. The fuel cell according to claim 23, wherein electrochemical oxidation of the solid-state organic fuel at the anode produces a product having a CO_2 concentration of at least 50 mol %.

34. The fuel cell according to claim 33, wherein the fuel cell has a maximum operating temperature that is less than 1200^0C.

35. The fuel cell according to claim 23, wherein electrochemical oxidation of the solid-state organic fuel at the anode produces a product having a NO_x concentration that is less than 0.1 mol %, wherein x represents integers ranging from 1 to 3.

36. The fuel cell according to claim 23, wherein the electrochemical-oxidation catalyst is selected from the group consisting of a noble metal, group VIII metal/metal oxide, such as Pt, Cu, Ag, Au, Pd, Ni, oxides of the aforementioned sulfur-resistant materials, oxides of Ce, Cr, Fe, and Pb, combinations thereof, multiple oxides, combinations including one or more of the aforementioned metals, Cu oxide-Pt, and Re-NiO/YSZ, wherein the electrochemical-oxidation

catalysts including non-noble metals also include a sulfur-resistant substance selected from the group consisting of Re, Mn, Mo, Ag, Cu, and Au.

37. A method of generating electric power from a solid-state organic fuel, said method comprising the steps of:

forming oxygen ions from an oxygen-containing source at a cathode;

transmitting the oxygen ions formed at the cathode to an anode with a solid-oxide electrolyte; and

catalyzing a reaction of the oxygen ions with the solid-state organic fuel to directly oxidize the solid-state organic fuel at the anode to produce a product comprising CO_2 and electrical energy.

38. The fuel cell according to claim 37, wherein the step of forming oxygen ions comprises the step catalyzing a reaction at the cathode with a lanthanum strontium manganese oxide catalyst according to the formula:

$$0_2 + 4e^- \rightarrow 20^{2-}$$

39. The fuel cell according to claim 37, wherein the step of catalyzing the reaction of the oxygen ions further comprises the steps of:

providing a catalyst comprising a sulfur-resistant material to the anode; and

directly electrochemically oxidizing the solid-state organic fuel according to the reaction:

$$C + 2O^{2-} \rightarrow CO_2 + 4e^-$$

40. A method of generating electric energy from a solid-state organic fuel, said method comprising the steps of:

establishing an ionic-communication channel between a cathode and an anode with a solid-oxide electrolyte

providing an electrochemical-oxidation catalyst that includes a sulfur-resistant material to the anode, wherein the electrochemical-oxidation catalyst promotes direct electrochemical oxidation of the solid-state organic fuel at the anode to produce a product comprising CO_2 and electrical energy;

providing an electrochemical-reduction catalyst to the cathode, wherein the electrochemical-reduction catalyst promotes the production of oxygen ions from an oxygen-containing source; and

forming a conductive channel to conduct the electrical energy away from the cathode.